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Durable Foe

Although man has waged systematic warfare on mosquitoes for close to a century, these pests remain a vexing and often serious problem. Mosquitoes harass man at work and play, and hinder the production of livestock and poultry. Some species carry diseases such as malaria and yellow fever to man, encephalitis to man and horses, and heartworm to dogs.

Entomologists who battle this cosmopolitan pest have engaged a many-faceted foe, one numbering more than 2,000 species of diverse form and habit. Accordingly, a control method devised for one species may be futile for another. Some mosquitoes prefer the blood of livestock to that of man, for example, while some species prey on reptiles and amphibians. Most mosquitoes travel no more than a mile, although a few species can fly 50 miles or more.

To complicate matters, our best insecticides lose their punch against these pests. Thus entomologists envision no single defense against mosquitoes, but rather an integrated control approach that combines chemical tools with biological methods.

ARS scientists are exploring varied approaches to mosquito control. A major effort involves finding infective but mosquito-specific biological control agents to mass produce and release into mosquito habitats. Such agents include: nematodes, protozoa, viruses, fungi, and bacteria. In related research, scientists are trying to breed hybrid mosquitoes that cannot survive in nature, and are testing growth-regulating hormones that arrest larval development. Recently, in El Salvador, they also successfully tested the sterile-male technique against the malaria-carrier *Anopheles*. Research on biological control agents is empirical and painstaking; a good example is the nematode *Reesimermis nielsenei* which, after 8 years of work, is ready for mass culturing.

Mechanical weapons also belong in the mosquito-fighter's arsenal. An ultra-low-volume sprayer pioneered by ARS for on-the-ground operations not only applies pesticides more efficiently, but also trims the total the total cost of control programs by two-thirds. Scientists have also devised ways to prevent certain mosquitoes from breeding: drilling vertical holes and filling them with gravel to drain depressions that catch rains, and installing grids to break up the water surface of cemetery vases, important but largely unsuspected sources of urban mosquitoes. Research will register further advances in the war on mosquitoes, but we need more effort and time.

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COVER: Immature male and female California Red Scales attached to lemon are magnified about 30 times in this photomicrograph. The male (bottom) is at the growth stage most susceptible to treatment with dichlorvos. Such treatment permits pheromone traps to replace visual inspection in control programs. (PN–2853). Article begins on page 8.

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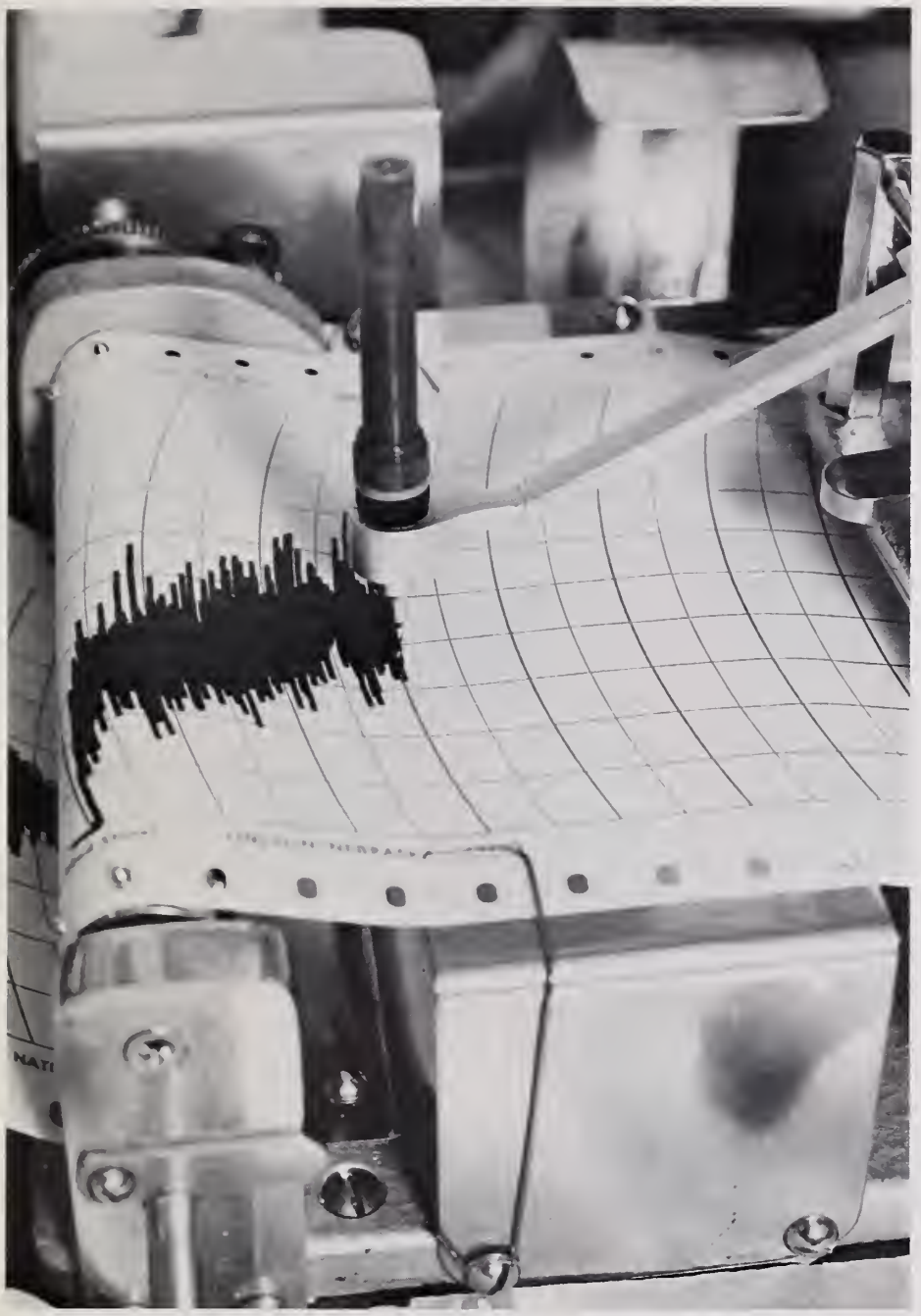


Physical forces exerted during the mixing of dough samples are translated onto this graph which enables researchers to interpret the baking properties of wheat flour (0673X1154–13).

The Mixograph

TEN GRAMS of wheat flour, less than one-twentieth the amount needed to fill a standard kitchen measuring cup, is enough for determining baking properties of an experimental wheat breeding line.

Scientists at the U.S. Grain Marketing Research Center, Manhattan, Kan., assess the breadmaking, or functional, properties of 1,000 to 2,000 early-generation hard winter wheat breeding lines a year with a precision micro instrument, the mixograph, that requires only a 10-gram sample of flour.

The 10-gram mixograph, designed by chemist Karl F. Finney and cereal technologist Merle D. Shogren, is a scaled-down version of a mixograph that is widely used in wheat quality laboratories but which requires a 35-gram sample of flour.

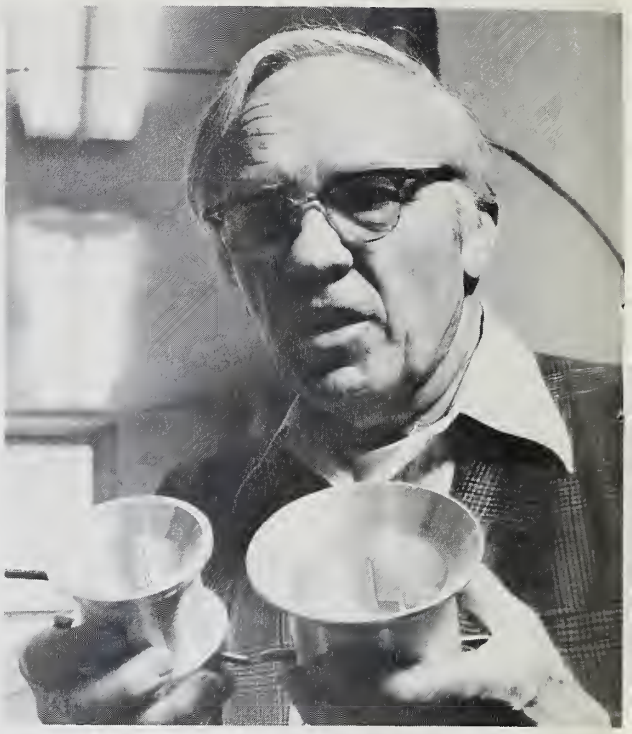
"The advantage of the 10-gram mixograph," Mr. Finney points out, "is that we can give the Federal or State wheat breeder accurate information on early-generation breeding lines. This shortens by 1 to 2 years the time required to develop improved bread wheats and lets the breeder know how flour from an experimental line is likely to perform in a commercial bakery."

Principal components of the mixograph include a bowl for flour and predetermined amounts of water, a motor-driven mixing head that kneads the flour and water into a progressively developed dough by the movement of two pairs of planetary pins around three stationary pins in the bowl, and a device that graphs the forces exerted in mixing. Flour, water, and the mixograph must be at uniform temperature. The initial amount of water added is dependent on the parental background of the wheat, moisture content, and flour protein content, which directly or indirectly affects all other properties.

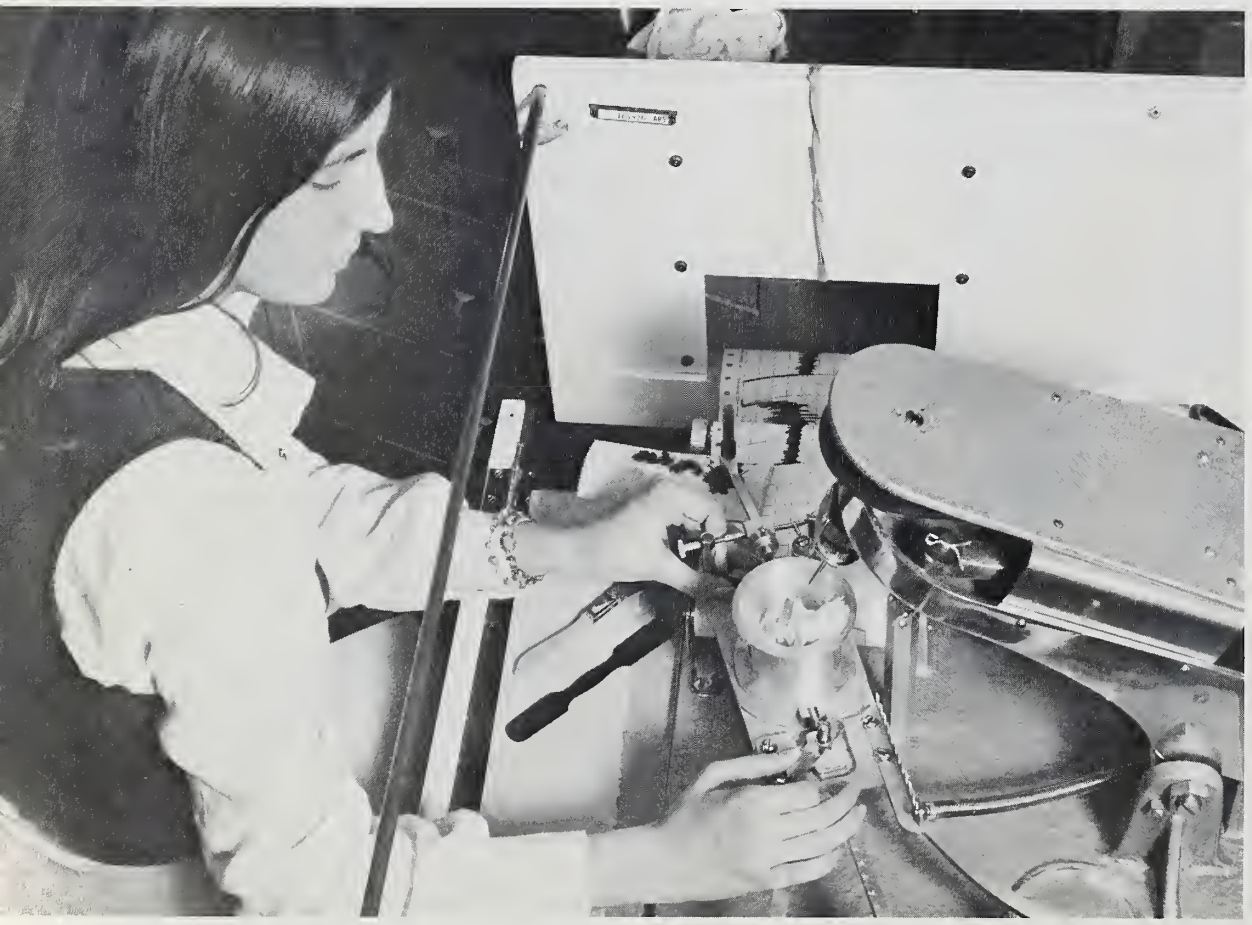
By interpreting the graph, or mixogram, Mr. Finney and his associates can directly determine three baking properties of wheat flour—mixing requirement, mixing tolerance, and water-absorption requirement—and can predict the oxidation requirement, dough-handling characteristics, and loaf volume.

An early generation breeding line that appears promising in initial milling and breadmaking quality evaluations as well as in production characteristics will be retained by the wheat breeder for additional evaluation. Mr. Finney notes that only a few of thousands of breeding lines survive the screening and selection process to be released as commercial varieties.

Research on wheat quality has been conducted at Manhattan, in cooperation with the Kansas Agricultural Experiment Station, since 1937. The Hard Winter Wheat Quality Laboratory has been a part of the U.S. Grain Marketing Research Center since 1972. □



Mr. Finney describes advantages of the smaller 10-gram mixograph sample bowl over the formerly used 35-gram bowl (0673X1154–23).



A test to determine the breadmaking properties of dough completed, technician Margo Shellenberger removes a 10-gram sample bowl from the mixograph. Visible in background are dough-covered stationary pins in the mixing bowl, the mixing head with its planetary pins, and the recording device (0673X1154–28)

Zeroing in on the Gulf Coast Tick

RESEARCH points to a new and potentially effective and inexpensive method for protecting cattle and other livestock from the Gulf Coast tick, *Amblyomma maculatum* Koch, a serious pest of livestock and wildlife, principally in the Gulf Coast States.

One of the more promising methods for controlling arthropods is the use of pheromones to disrupt mating behavior and for trapping and surveying the pests. Despite the strides made in the past 10 years in the study of pheromones of insect species, study of these chemicals on the behavior of ticks has been lacking.

Now, recent research offers evidence of a pheromone produced by male Gulf Coast ticks that attracts female ticks for considerable distances over the body of a bovine host. Usually it is the female pheromone that is used to attract the male of the species. Earlier tests with other species of ticks, however, indicated that although males were excited by the female pheromone they were not drawn over long distances to seek the source.

Although the researchers, entomologist William J. Gladney, chemists Rolland R. Grabbe and Delbert D. Oehler, and biological technician Stanley E. Ernst have not yet isolated the pheromone, they have made and used hexane extracts of male ticks. Their tests were conducted at the U.S. Livestock Insects Laboratory, Kerrville, Tex.

In the first of three tests the scientists applied the extract to a shorn 6-inch circle on one shoulder of each of four confined animals.

Ten minutes after applying the extract, the researchers released 150 female ticks on each animal. The ticks were separated into three groups of 50 ticks each and each group was marked with a different color fluorescent dye.

In test No. 2, a procedure similar to that of test No. 1 was employed except that a tiny amount of insecticide (izobenzan) was added to the extract made from male ticks.

Because the ears of animals are generally preferred by the Gulf Coast tick, the researchers decided to conduct still a third test. In this test, the extract, without insecticide, was applied to the inner surface of one ear of each of four animals. Again, female ticks were released.

The results of all three tests indicated that odors emitted by male ticks may be used to lure female ticks to small areas on hosts.

The results also indicate that the addition of an insecticide to the chemical coupled with spot application is a promising method for control.

Results of test No. 1 showed that 35.2 percent of the marked ticks released on the animals found their way to and attached themselves to the 6-inch diameter treated circle within the first 24 hours following release. Another 12.1 percent of the total ticks released were found on other parts of the animals, notably in and around the ears. After 15 days no female ticks were found on the animals except in the treated area and in the ears.

In a check of the animals in test No. 2—the one incorporating the insecticide—the researchers found only 7 percent of the ticks, indicating that the ticks had been attracted to the treated circle and were apparently killed by the insecticide even before they could attach. If the insecticide was responsible for the reduction, the treatment gave 85 percent control.

The results of test No. 3 indicated that after 24 hours more than four times as many ticks were attached to the treated ears as were attached to the untreated ears, 32 percent and 7.5 percent, respectively. □

Research technician Sharon Schureman and Dr. Kishaba take almost parental pride in the fruit of a hybrid muskmelon bred and selected for disease and insect resistance (0374X361–23).

Breeding a 'perfect' melon

Mrs. Schureman places cages containing five aphids on leaves to test for antibiosis in hybrid muskmelon plants. The cages are made of sponge plastic to minimize damage to plants (0374X361–15).

A "PERFECT" MUSKMELON, high in quality with built-in resistance to insects and diseases.

That is the goal of three ARS scientists in Southern California who are breeding melons for multiple resistance to several pests and pathogens that presently limit yield and quality of the popular fruit. If uncontrolled, these melon enemies take millions of dollars annually out of the pockets of U.S. growers.

About the only recourse producers now have is to spray pests with insecticides and fungicides—not only costly in labor and materials but environmentally undesirable.

One such pest, the melon aphid that curls the leaves, then stunts and kills North American muskmelon cultivars, may have to find itself another food source.

Plant geneticist Guy W. Bohn, Brawley, and entomologists Albert N. Kishaba and Harold H. Toba, Riverside, have found the possible key to developing aphid resistance in U.S. commercial varieties in an Old World cultivar from Northern India. The India melon bears little resemblance to U.S. melons; it is soft at maturity, has mealy, nonsweet flesh, and is used in soups and stews rather than as a table delicacy.

Looks and taste, however, make little difference to Dr. Bohn. He noted that India melon plants grown from seeds obtained from ARS plant explorers showed marked field resistance to melon aphids. The same field resistance was shown in greenhouse tests at Riverside to be based upon nonpreference, tolerance, and antibiosis. The plant also showed some resistance to diseases such as powdery mildew. These attributes of resistance can be bred into dessert quality U.S. cultivars while still retaining high melon quality.

Nonpreference causes insects to move to flowers or buds or to leave the plant altogether because they do not like its taste.

Tolerance enables the plant, even if attacked by aphids, to survive with little to moderate injury while a plant of a susceptible variety would die.

Antibiosis causes deleterious effects of the plant on the aphid, slows its

growth rate, and reduces the adult size of the insect. Antibiosis also reduces the fertility of the aphids and it is this attribute the scientists use for measuring antibiosis.

The scientists bred the India melon with a commercial variety to produce the ninth backcross and also made selections for tolerance, antibiosis, and quality in each generation. Then they ran comparison tests for aphid resistance.

Twenty aphid nymphs—five in separate cages placed over four individual melon leaves—yielded an average of 400 aphid progeny on susceptible plants after 7 days. In contrast, inbred resistant plants yielded only about 40. First generation hybrids—from India x's U.S. commercial—yielded about 100 aphids. Segregates in backcross populations usually yielded from 100 to 300 aphids. Tolerant plants that yielded 100 or fewer aphids in the antibiosis test were selected in each backcross generation.

Despite the complex nature of aphid resistance and its genetic controls, the scientists recognized both tolerance and antibiosis in hybrids. They then used the direct backcross breeding procedure to combine aphid resistance with high melon quality and resistance to powdery mildew, downy mildew, watermelon mosaic virus (1), and mites. Every generation was carefully selected for the most resistant plants.

During 3½ years of research, about 75,000 plants have been tested for tolerance and about 18,000 for antibiosis. The researchers have cross-pollinated or selfed about 3,000 plants in 10 generations to produce the ninth backcrosses and F4 hybrids from sixth backcrosses.

Field trials at the University of California South Coast Field Station, Irvine, and the Imperial Valley Conservation Research Center, Brawley, have indicated that greenhouse testing and breeding procedures were effective in combining resistance with quality, and that this resistance is effective in the field.

The research will continue until the scientists are satisfied they have bred the "perfect" melon. □

Northern Indian melons on left are used for cooking in their homeland; U.S. Commercial melons are on right (PN–2858).

Dr. Bohn and supervisor Jack A. Robertson discussing the selection of breeding stock from this muskmelon crop. The plants are being grown on the southern slope of the bed to capture the low winter sun; they are "capped" to protect them against frost (0374X361–2).

Better way to detect red scale

Cost of detecting the California Red Scale—a citrus insect pest—can be greatly reduced by relying on pheromone traps instead of visual inspection of orchards. And these costs can be reduced even further by chemically separating male and female red scales.

The chemical method is now in use by commercial insectaries, by a red scale eradication district in the Coachella Valley of California, and by ARS researchers who developed it. Currently, it is saving the three users more than $25,000 a year.

The new orchard survey tool consists of a pint-size ice cream carton cage containing live mature virgin females feeding on a lemon. Female scales produce a sex attractant—pheromone—which attracts winged adult male scales, trapping them when they fly onto a sticky card attached above the cage. Female scales do not fly.

The research was conducted at Riverside, Calif. by ARS entomologists John G. Shaw, Daniel S. Moreno, Joann Fargerlund, and R. P. Sunderman, formerly of ARS.

Early detection of spot infestation enables growers to minimize their spray operation to small areas, thereby leading to savings of millions of dollars in California alone.

To get unmated virgins for the traps heretofore required isolation of females at the immature stage by hand removal of the males from infested lemons—a slow, tedious, and costly procedure.

Now ARS entomologists use an insecticide—dichlorvos—in an aqueous solution to dip the infested lemons and kill the males before they emerge and mate with the females. Females are little harmed by the treatment, remaining as attractive to males as those isolated by the hand-removal technique.

It previously took about 10 minutes per lemon to pick off and kill the male red scales by hand. But by using dichlorvos—at the right time—the rate of processing can be increased to at least 100 lemons per 10 minutes.

Chemical separation is based on exploiting a peculiarity in the red scale's life cycle involving a "unique" difference between the way the sexes develop.

The female gives birth to live young—called crawlers—and the life cycle from crawler to crawler is 43 days at 25° C. and 70 percent relative humidity. When the crawler changes its morphology, it exudes a waxy material

Far Left: Close-up photo of infested lemons ready for immersion in Vapona solution to kill California red scale males (0374X301–24A). Left: Technician Joann Fargerlund dips infested lemons, then puts treated lemons back on tray (0374X304–15).

covered with a shellac-like substance that looks like a small scale on the surface of the fruit, hence the name. That's the first molt.

During the second instar period—between the first and second molt—or about 14 days after the crawler stage, the insect continues to grow, increasing in size and increasing the size of its scale. It is at this stage that the difference between male and female can be detected visually. The male is oblong while the female is circular and a couple of dots—eyes—can be seen on the male.

As the insects go into the second molt, about the 16th to 17th day—the female becomes tightly bound to the lemon and the scale is tightly bound to her body.

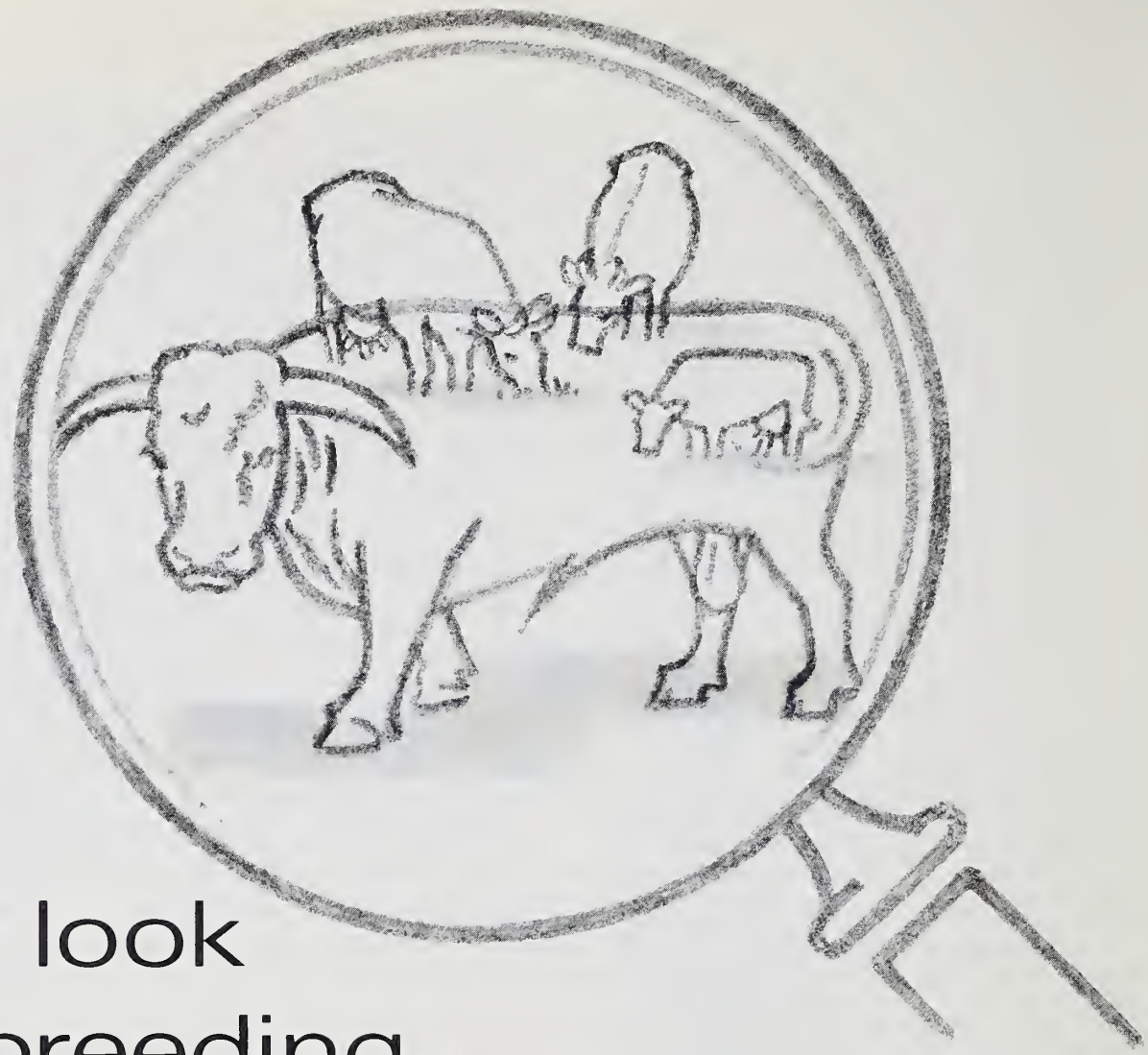
Not so the male. He is loosely bound to the fruit and the scale is loosely bound to his body. It is at this time that the fruit can be dipped in dichlorvos, killing the male while the female's protective scale saves her.

Winged males start emerging from the scale at about the 23rd day, live only 1 day with only one purpose, to mate. The female stays in one place all of her life, she has no wings, does not move, and once mated she is no longer attractive to males.

In these studies, the lowest mortality of females—from 24 to 41 percent—occurred when they were 16 to 18 days old at the time of treatment, that is, when 74 to 94 percent were in the second molt and none had loosened from their covers. Treatment at that time yielded an average 64 percent live virgin females. Mortality was 57 percent when the females were 15 days old and 54 to 92 percent when they were 19 to 23 days old. Males were susceptible at all those ages, their mortality ranging from 94 to 100 percent.

This research was conducted in cooperation with the California Agricultural Experiment Station, Riverside. □

Above: Laboratory assistant Harley Einspahr records field catches of mature male scales captured on sticky surfaces of cards that were attached above cages holding females (0374X303–33A). Left: Dr. Shaw checks lemons in room for mass rearing of scales. Paraffin darkens tips of lemons; they have been treated to minimize desiccation and to facilitate the crawling of new-born scales onto new fruit where they will settle and reproduce (0374X302–30A).



A closer look at crossbreeding

BEEF CATTLE breeding herds A and B are similar in type, size, and management. Yet, at weaning time herd A produces 23 percent more pounds of calf per cow exposed to breeding.

The difference is that a well-planned system of crossbreeding is used in herd A, while herd B produces straightbreds of a single breed.

The herds are fictitious, but the potential advantage of crossbreeding is real, as indicated by long-term studies at the U.S. Meat Animal Research Center, Clay Center, Nebr., in cooperation with the Nebraska Agricultural Experiment Station, Lincoln.

Crossbreeding can take advantage of heterosis or hybrid vigor, the response in an animal from the cross of parents carrying many unlike genes. The studies were initiated at Fort Robinson, Nebr., in 1957 to determine the influence of heterosis on economic traits in beef cattle over four generations of systematic crossbreeding.

Overall, the effects of heterosis significantly reduced the age when heifers reached puberty, reduced the interval from calving to first estrus, and advanced the average date of conception. Additional heterosis effects included these increases: in first-service conception rate, number of conceptions per service, pregnancy rate, percentage calf crop, and weight of calf weaned per cow exposed to bulls in the breeding herd.

The first phase of the study compared straightbred Hereford, Angus, and Shorthorn calves with all possible crosses involving the three breeds (AGR. RES., March 1967, p. 10). The effects of heterosis—the difference between averages of parent straightbreds and crossbreds—included a 3-percent increase in percentage of calves weaned and a 19.4-pound boost in average weaning weight of calves at 200 days. An even more meaningful effect, reflecting the combined responses in reproduction, survival, and growth rate in crossbreds, is the advantage of 28.8 pounds or 8.5 percent, in average weaning weight per cow in the breeding herd.

The crossbred steers gained 2.9 percent more than straightbred steers in the feedlot and produced trimmed-boneless beef that netted $8.81, or 4.2 percent, more per head over feed costs. Differences in feed efficiency and carcass composition were small.

Heifers from the first phase of the study were retained by geneticists Larry V. Cundiff, Keith E. Gregory, and Robert M. Koch for the second part of the study. Phase II involved 570 matings of straightbred cows and 687 matings of crossbred cows over six breeding seasons. Approximately half of the females were managed for calving as 2-

year-olds and half as 3-year-olds.

Researchers determined the influence of heterosis as the difference between reciprocal crossbred and straightbred females when both were mated to bulls of a third breed. For example, females sired by Hereford bulls out of Angus cows and the reciprocal cross, females sired by Angus bulls out of Hereford cows, were compared with straightbred Hereford and Angus females when all were mated to the same Shorthorn bulls.

In Phase II, an increase of 50.8 pounds, or 14.8 percent, in weight of calves at weaning per cow exposed to breeding was attributed to the effects of heterosis. The calf crop weaned in Phase II was 6.4 percent more for crossbred than for straightbred cows because of higher pregnancy rates and first-service conception rates in the crossbreds. They also produced significantly more milk than straightbreds, as reflected in 4.3 percent heavier calf weights.

The cumulative influence in heterosis is the sum of individual heterosis in Phase I and maternal heterosis in Phase II. The 8.5 percent advantage in weight of calf weaned per cow exposed to breeding in Phase I plus the 14.8 percent advantage in Phase II combined to yield a cumulative advantage for crossbreds of more than 23 percent, or almost 79 pounds, in the study.

Differences in management significantly influenced heterosis effects in the first calf crop. Under management for first calving as 3-year-olds, the effects on percentages of calves alive at birth and at 2 weeks were significantly greater than under management for first calving as 2-year-olds. Differences between the two groups were small in subsequent calving seasons as the cows advanced in age. Management for first calving as 2-year-olds therefore has the potential advantage of adding one calf to the cow's lifetime production.

The third phase of the experiment is comparing three systems of crossbreeding for commercial beef production, along with control lines of the Hereford, Angus, and Shorthorn breeds. □

Graded furrows or terraces?

GRADED FURROW systems outperform terraced systems. Clarence W. Richardson, agricultural engineer at the ARS Blackland Research Center, Temple, Tex., found this to be true in research comparing runoff, soil loss, and farm tillage efficiencies. His studies were conducted on field-size plots comparing a graded furrow system and a comparable area utilizing a standard terrace system.

With the introduction of mechanized farming methods, terracing, the traditional technique for controlling soil erosion, has been found unsatisfactory due to the difficulty of employing present-day farm equipment to work these fields.

Mr. Richardson's project was based on a 3-year crop rotation of cotton, grain sorghum, and oats. The graded furrow system was constructed on an 11-acre site near Riesel, Tex.

Each furrow was designed to carry only the runoff that originated on the furrow itself; therefore runoff from outside sources would overtax the furrow capacity and overtop the ridge of the furrow. For this reason diversion channels were constructed above the top furrow of the field to convey the runoff from the ungraded area above the graded furrow field to a separate waterway.

During the test period there were 28 runoff-producing storms. The average annual rainfall during the project was 32.76 inches.

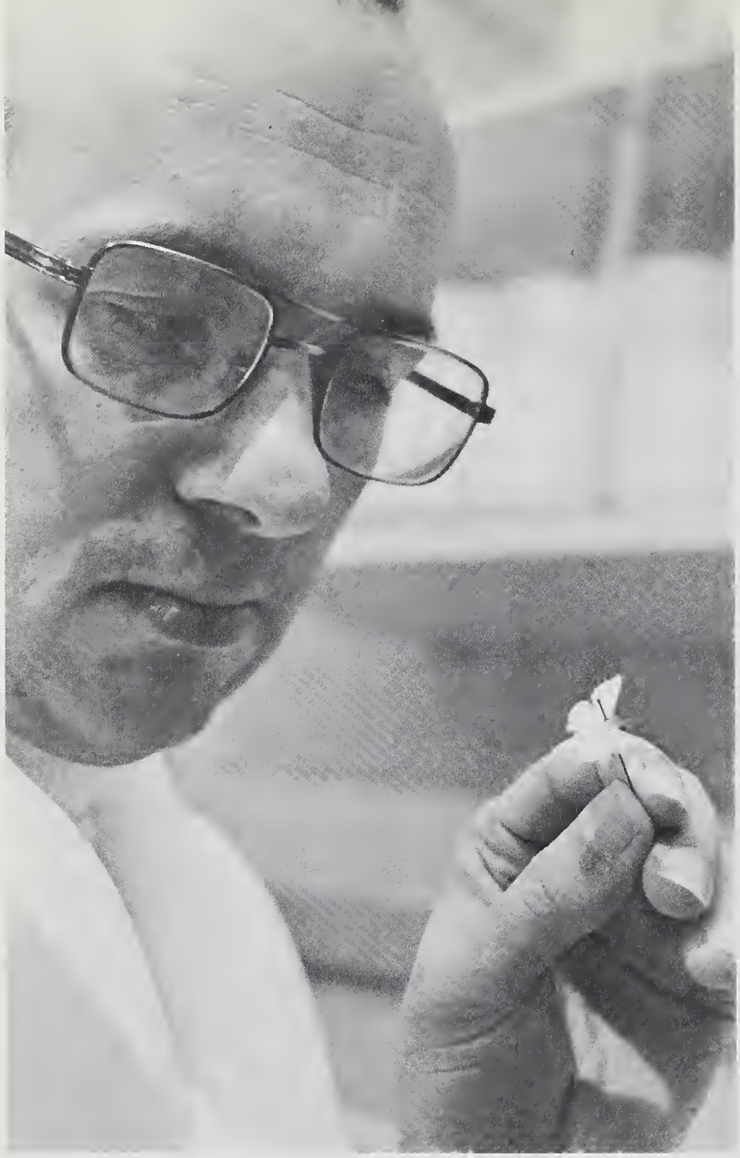
Runoff from the terraced watershed (TW) generally exceeded that from the graded furrow watershed (GFW) during most storms. Reduced runoff on the GFW was probably due to more uniform distribution of excess water on the GFW than on the TW, where the excess water was concentrated in the terrace channels.

Although erosion was minor on both watersheds, it was generally greater in the GFW than the TW, except during small runoff-producing storms. During the 3-year period the GFW averaged 1.38 tons of soil erosion per acre, whereas the TW averaged 1.09 tons per acre.

The design of the graded furrow system was put to a severe test during an intense storm when a total of 4.42 inches of rain fell, with 1.06 inches falling within 20 minutes. This storm caused extensive interterrace erosion and sediment deposition in terrace channels. The graded furrow system, however, conveyed runoff rainwater into the drainage waterway without overtopping the ridges or causing serious erosion problems.

On the average, the GFW tillage rate was 21 percent faster than the TW. Only the 1969 seedbed preparation and cotton harvest tasks were accomplished more quickly in the terraced area. This was due partially to additional initial bed preparation and poorly adapted machinery in the graded furrow area.

Fewer turns on the long parallel rows in the GFW area, as compared to the many point rows in the TW area, resulted in faster tillage of the fields. Also the time-consuming tasks of maintaining terrace channels and ridges were eliminated with the graded furrow system. □



Dr. Proshold examines one of the hybrid tobacco budworms produced to serve as potential biological control agent of this pest of cotton and tobacco (0174X55–42).

Genetics vs. tobacco budworm

A HYBRID INSECT that mates with the tobacco budworm moth but produces no offspring could have an important role in controlling this important pest of cotton and tobacco.

The first step toward genetic control of the tobacco budworm has been taken at Stoneville, Miss., by Mississippi Agricultural Experiment Station entomologist Marion L. Laster and at Fargo, N. Dak., by ARS entomologist Frederick I. Proshold and geneticist Leo E. LaChance. They produced hybrids by crossing the budworm (*Heliothis virescens*) with *Heliothis subflexa*, a closely related species collected as larvae from ground-cherries in Mississippi.

The most promising hybrid in the studies at the Metabolism and Radiation Research Laboratory is the result of mating *H. subflexa* females and budworm males. The hybrid males were sterile, with few exceptions, and the hybrid females produced sterile sons through two generations when mated with tobacco budworm males.

Dr. Proshold said that the hybrid females did not mate readily—about 40 percent entered diapause without mating—and laid few eggs.

The researchers found that sterility in both hybrid males and sons of hybrid females was the result of failure to transfer one of two kinds of sperm during mating, although they produced both kinds. This failure may be associated with abnormal pairings of chromosomes in the hybrid males—20 to 28 pairs instead of the normal 31 pairs.

Whether large numbers of the hybrids could be produced in the laboratory for release is yet to be determined. Only 56 percent of the *H. subflexa* females caged with budworm males produced progeny, although 90 percent of the budworm females caged with budworm males had offspring. Ability of the hybrids to compete successfully for mates in nature is also unknown.

Should further research indicate that the hybrids can be mass-produced and would be competitive, Dr. Proshold

suggests two ways they might be used in integrated control programs:

Hybrid males only might be mass-released into the native population, where they would mate with budworm females but produce no offspring. This method would be similar to the sterile-male release technique but no treatment of males would be required.

An alternative would be to release both hybrid males and females. Again, the sterile males would mate with native females but would have no progeny.

The relatively few hybrid females that successfully mated would produce sterile sons in succeeding generations.

The hybrid resulting from the reciprocal cross of tobacco budworm females and *H. subflexa* males was less promising. Only 20 percent had progeny. The hybrid males from this cross mated but did not transfer sperm readily. These hybrid females did not diapause and mated readily but their fertility was low. Crossing these females with budworm males partially or completely restored fertility in their sons by the third generation. □

Above: *Technician dissects* Heliothis *female, checking for evidence of mating and sperm transfer (0174X55–36).* ***Lower Left:*** *Temperature and humidity of rearing room—critical factors in mass production of* Heliothis*—are monitored by delicate instruments being checked by Dr. Proshold (0174X55–2).* ***Lower Right:*** Heliothis *eggs are carefully plated prior to placement in rearing chambers (0174X55–26).*

Advancing against Salmonella

With a highly sensitive, accurate procedure which can accredit poultry flocks as free of exposure to salmonella organisms, ARS research is pointing the way to safer poultry products for the consumer. Salmonella infections from poultry rate high among causes of food poisoning in humans.

Poultry is the most common carrier of salmonella, which may contaminate marketed chicken, turkey, and unpasteurized eggs. Although USDA standards are enforced to protect the consumer against diseases, the new microantiglobulin test (MAG) for detecting salmonella infection in breeding flocks is an important move toward suppression.

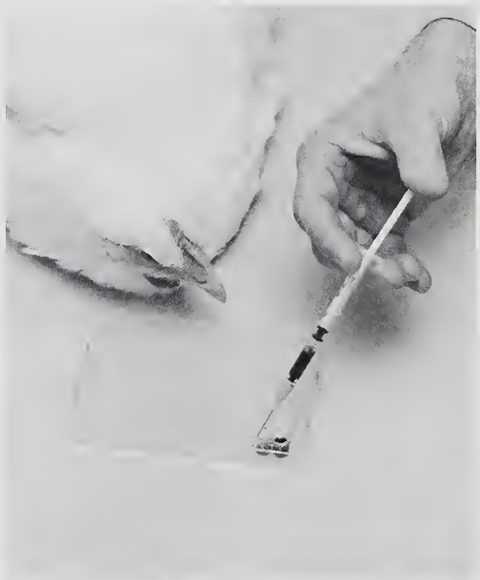
The MAG test not only identifies flocks actually carrying salmonellae, but also flocks which have been exposed. "Eighty-five percent of salmonella infections in the United States are due to Groups B, C, D, and E," said veterinary scientist James E. Williams at ARS' Southeast Poultry Research Laboratory in Athens, Ga. Based on the clumping reaction of bacterial cells suspended in liquid, the MAG test for Group B, C, D, and eventually for E, is the first application of the procedure using bacterial antigens.

Microtesting conserves time and reagents, substances causing chemical reactions by which other substances may be detected. It offers savings in cost and space compared to macrotesting, a conventional method requiring manual handling and individual viewing in test tubes. "More important," said Dr. Williams, "the MAG test identifies flocks merely exposed to salmonella which macrotesting does not always do."

Employing the use of a purple-stained bacterial cell suspension for mixing with serum samples, the adapted microtest reduces the volumes of reagents by three-fourths. Serum is analyzed in small, disposable plastic plates with 96 tiny depressions. Test results can be quickly interpreted by viewing the bottom of the microplates.

In the sensitive MAC test, the plates are loaded into centrifuge carriers and centrifuged for 10 minutes at 900–1500 rpm. The centrifuge is stopped without braking so that the settled cells will not be disturbed. After the extraneous surface fluid is removed, the packed cells are resuspended at numerical intervals in a normal saline solution. Rabbit anti-chicken globulin serum is added to each of the 96 wells and the plates are then incubated at 37°C. for 18–24 hours.

The cheaper and more easily applied microtests are under active application in salmonella testing programs in five States, adding significantly improved surveillance techniques to present methods of control. □



Above: *Fresh sample of blood collected from a chicken is deposited into well of a silicone-treated microtest plate to allow serum separation and multiple sample pickup for microantiglobulin testing (BN–41069).* ***Upper Right:*** *Technician Alton D. Whittemore loads centrifuge with microtest plate carriers to wash bacterial cells for the microantiglobulin test (BN–41068).* ***Lower Right:*** *Dr. Williams employs the manually-operated 12-channel dispenser to add a suspension of killed bacterial cells to serum dilutions. This is one of the first steps in conducting the microantiglobulin test for salmonella (BN–41067).*

AGRISEARCH NOTES

Resistant lines of cotton

BREEDING does tell. Two damaging pests of cotton—root-knot nematodes and fusarium wilt disease—may now be successfully controlled by new resistant breeding lines. The significant breakthrough is based on years of research indicating that breeding for wilt resistance is primarily a problem of breeding for nematode resistance. No upland cotton variety without some degree of resistance to the nematodes has shown tolerance to wilt.

Root-knots are caused by the penetration of the plant roots by minute, eellike parasitic nematodes which stimulate cell development. This in turn causes galls, a tumorous knobby enlargement of the root system. The host plant is then prey to fusarium wilt, a fungus disease which enters the injured roots and spreads through the water-conducting tissues. Fusarium causes leaf yellowing, fast wilting, leaf drop, and early plant death.

ARS agronomists at Auburn, Ala., have developed two F_{10} (tenth filial generation) cotton breeding lines, A623 and A61, through a root-knot tolerant primitive strain, Mexico Wild. These two lines have exceptionally high root-knot and fusarium wilt resistance. They also showed the same high resistance when exposed to root-knot nematode strains from Alabama, Arizona, Louisiana, and Missouri.

From 210 F_6 families, selections with high resistance were obtained from only six families, two of which were progenitors of A623 and A61. In F_9 families, selection was also conducted for agronomic potential in field nurseries.

A623 and A61 exhibited the highest root-knot resistance known in cotton. Each of these new genetic combinations was a transgressive segregate with a higher level of resistance than its parents.

"If A623 and A61 resistance can be transferred to cotton varieties, it may not be necessary to breed for resistance to both root-knot and fusarium," said agronomist Raymond L. Shepherd. "Certainly A623 and A61 offer great potential for breeding resistant commercial varieties for the Cotton Belt."

The research was conducted by Dr. Shepherd at the ARS Crops Science Research Unit, Auburn, Ala., in cooperation with the Alabama Agricultural Experiment Station, Auburn University.

Light affects looper oviposition

OVIPOSITION—egg laying ability—of female cabbage loopers is evidently affected by the type of light they are exposed to under the artificial conditions of insect laboratories.

ARS researchers at Mesa, Ariz., have found that female loopers lay 31 percent more eggs when illuminated under fluorescent plant lamps than when fluorescent cool white lamps are used.

In laboratories raising loopers for field and laboratory tests, fluorescent light is used in place of natural sunlight to illuminate oviposition cages.

ARS biological laboratory technician Merrill A. Petterson says that while oviposition increased greatly, the percentage of hatch and the number of abnormal eggs remained about the same.

Conclusions are that by using the plant lamp, fewer moths are needed to produce the same number of eggs.

This finding should result in a savings at all stages of production of cabbage loopers whether used for routine maintenance of a laboratory culture or for mass rearing for population suppression studies.

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AGRISEARCH NOTES

Toward effective windbreaks

TEMPORARY wind barriers—including corn rows, sunflower rows, snowfences, and solid board fence—each have characteristic effects on wind turbulence and structure.

Soil scientist Jerry K. Radke, who conducted studies on wind barriers at Morris, Minn., in cooperation with the Minnesota Agricultural Experiment Station, St. Paul, said knowledge of these characteristics may help agricultural engineers design improved windbreaks to deal with strong drying winds that often seriously reduce crop yields in some areas. The research also points to the possibility of designing more effective windbreaks for livestock, highway rest stops, backyard patios, and for snow catches in the Great Plains.

In his studies, Dr. Radke computed models of wind turbulence which characterize the wind and may aid understanding of why sheltered plants can photosynthesize at a faster rate and produce more plant material than unsheltered plants.

Instruments used to measure wind velocity fluctuations, called hot-film anemometers, and a recording wind vane provided data which were fed into an instrument called a correlator, where turbulence and wind pattern characteristics were resolved. The data was further analyzed by a computer.

The characteristic effects on wind by each of the barriers were related to the barrier's porosity, structure, and flexibility. Generally, barriers that were porous and flexible were the most effective windbreaks.

Nitrates in abandoned feedlots

ABANDONED beef feedlots are more likely to be sources of localized nitrate pollution of ground water than feedlots in active use.

Nitrate-nitrogen levels averaged 3.2 tons per acre in samples of the soil profile to 30-foot depth under abandoned feedlots in ARS-Nebraska studies conducted by soil scientist Lloyd N. Mielke and microbiologist James R. Ellis, both of ARS. Similar samples showed only 0.8 ton per acre under active sloping feedlots and 0.27 ton per acre under active river valley feedlots.

Under active feedlots, Mr. Mielke explained, nitrogen builds up in relatively immobile organic form, mainly in the top 5 to 6 feet of soil. In abandoned feedlots, organic nitrogen is mineralized to the nitrate form that moves down through the soil with moisture once the relatively impenetrable surface seal on active feedlots breaks down.

The highest nitrate level noted in the experiments was 8.5 tons per acre in a soil sample to 45-foot depth from an abandoned feedlot that had not been cropped. Samples from a former feedlot cropped to corn and alfalfa for 15 years, however, had nitrate levels comparable to those from adjacent cropland. Mr. Mielke said studies are underway at Lincoln to determine the most effective way to reclaim abandoned feedlots by cropping to prevent potential groundwater pollution.

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